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(54) Hot fill thermoplastic container.

(57) A method of hot filling a thermoplastic container so as to avoid deformation and collapse of the container, which comprises the steps of continuously applying a vacuum means to the original side walls of a thermoplastic container so as to draw out concave indentations in said original side walls of said container into a convex shape, filling the container with desired contents during continuous application of the vacuum means, sealing the container by an appropriate sealing means during continuous application of the vacuum means, discontinuing the vacuum means, and cooling the container, whose convex side walls, in the absence of the external vacuum, invert to indentations of a concave shape, which was its original formed shape.

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Description

HOT FILL THERMOPLASTIC CONTAINER

This invention relates to a method of hot filling a thermoplastic container. More particularly, this invention relates to a method of hot filling a thermoplastic container so as to avoid deformation and collapse of the container under internal vacuum caused by subsequent cooling of the container and contents.

When foods are packaged in rigid containers, they are frequently filled with liquid food stuffs at an elevated temperature of about 190 or 200 °F to destroy bacteria. This is referred to as "hot filling". After the filling, the head space is often purged with inert gas to reduce the oxygen content and the lid or closure is sealed while the contents are still hot and the sealed container is then cooled to room temperature. At the hot fill temperature, the vapour pressure of water is about 10 psi or 500 mm of Hg. Sealing takes place at atmospheric pressure of 15 psi so that the head space in the can may very well be occupied more by water vapour (by volume) than by air or inert gas. When the can is cooled, the water vapour pressure is reduced to a level of only about .5 psi and the water vapour in the head space condenses, thus creating a vacuum. This vacuum could be as much as 9 psi if the air space has been saturated with water vapour, but usually the air space does not approach the saturation point so that the vacuum created is typically in the region of one to three psi. However, this is still enough to cause vacuum collapse of many plastic containers.

Containers having flexible bottom walls to accommodate the development of a vacuum within are well known and commercially available. US patent No. 4,255,457 and US patent No. 4,219,578 are both concerned with an anti-buckling device for beer cans. They disclose the use of an anti-buckle ring which braces the can's interbase wall and first and second radius portions from substantially interradial displacement.

US patent No. 4,125,632 discloses a method for the production of a container body which is originally manufactured with a convex base. The material in the convex base is thinner than that in the side wall.

Reissue US patent No. 31,762 discloses a container which, as originally manufactured, contains a side wall convex "bulge".

US patent No. 4,125,632 provides a weak bottom for collapse in preference to the side walls but without any controlled volume change or use of vacuum draw down.

One solution has been to make the container walls and base very thick so that they can resist collapse, but this is economically unattractive and sometimes difficult to accomplish. Applicant's idea is aimed at artificially increasing the internal pressure within the container, thus reducing the vacuum and the tendency of the side walls to collapse.

Applicant's invention comprises a process for hot filling a thermoplastic container, so as to avoid deformation and collapse of the container, which comprises the steps of:

- continuously applying a vacuum means to the original side walls of a thermoplastic container so as to draw out concave indentations in said original side walls of said container into a convex shape;
- filling said container with desired contents, during continuous application of said vacuum means;
- sealing said container by an appropriate sealing means during continuous application of said vacuum means;
- discontinuing said vacuum means; and
- cooling said container so that said convex side walls of said container invert to said indentations of a concave shape.

Figure 1 illustrates the thermoplastic container as originally manufactured, with side wall indentations, for example, in the form of ridges or grooves in a concave shape.

Figure 2 illustrates a bottom cross-sectional view of the fluted container.

Figure 3 illustrates the continuous application of vacuum means to the side walls of the container to draw out the indentations to a convex shape.

Containers are typically hot filled and packaged with enough air space so that after cooling 10% or more (sometimes much more) of the volume of the container will remain filled with air or some inert gas used to reduce the oxygen content. This is to prevent spillage upon opening the container by the consumer. The air space at equilibrium before cooling contains about two thirds by volume water vapour, and after cooling only about 3% water vapour. If the container remains rigid, as in the case of a metal can, a vacuum of about 10 psi can result. Plastic containers do not possess the rigidity of metal cans and thus collapse under very slight vacuum often as little as 1 psi. This means that a volume change equal to more than half of the initial air volume is required to eliminate the vacuum.

The container 8 of the present invention is constructed with side walls 9 which contain some kind of indentation 10, for example, ridges or grooves as illustrated in Figure 1. By indentation, it is meant that the container is bowed inward or curved inward in at least one place. This is typical of jelly moulds, for example. Concave is defined as "a rounding or curving inward". Convex is defined as "a rounding or curving outward". At the point of hot filling, as seen in Figure 2, a vacuum means 11 is applied continuously to the original side walls 9 of thermoplastic container 8 so as to draw out indentations 10 of side walls 9 of container 8 into a convex shape. This increases the volume of container 8. Container 8 is now filled with desired contents 12 during continuous application of the vacuum means 11.

As seen in Figure 3, the cover seal 13 of the container 8 is attached by an appropriate sealing means still during continuous application of vacuum means 11.

The vacuum means 11 is discontinued and

container 8 is cooled so that indentations 10 of side walls 9 of container 8 invert to their original concave shape. By reducing the volume of container 8 after sealing. the head space is reduced thus compressing the air therein and creating a positive internal pressure which will reduce the vacuum created upon cooling. The amount of positive pressure created will be proportional to the ratio of the head space before and after the suck down vacuum is released. In most cases, inversion of indentations 10 of side walls 9 will take place spontaneously. If not, some type of mechanical assist may be used to achieve inversion.

An optional use of a positive stop device which is adjustable to allow regulation of the amount of draw down desired for container 8, may be used. A positive stop device would allow a uniformity of drawout of the containers to be achieved.

Example 1

A fluted cranberry cup of 500 ml product capacity designed to hold 500 ml of product with 100 ml of vapour space. The indentations of the side walls are drawn out into a convex shape by vacuum so that the volume becomes 700 mils. Upon filling with 500 mils of product at 200 °F and sealing with vacuum on, it results in 200 mils of head space consisting of air and water vapour at 15 psi. If we assume the pressure of water vapour in the head space is 7.5 psi, then the air or nitrogen pressure is also 7.5 psi. Upon release of the vacuum, the indentations of the side walls snap back in and the head space is reduced to 100 mils, thus compressing the vapour volume by a factor of two and raising the total pressure to about 30 psi. When the contents are cooled, the water vapour condenses out and drops to a water partial pressure of about .5 psi. The pressure of nitrogen is 15 psi, thus the total internal pressure is about 15.5 psi. The container which results is significantly free of deformation and collapse of the side walls.

The sealing of the containers may be by use of any standard sealing mechanism which may include paper, foil or other types of covers which may be attached by adhesives, heat welding, sonic welding, or double seaming or any other method.

It will become apparent that it is much easier for the indentations of the side walls of the container to snap back to a more original, familiar position than it would be to snap into a totally new position, such as is the case in some of the patents which provide for manufacture of a container which originally contained a convex bulge in the side walls. In addition, the side walls of applicant's invention do not have to be made of thicker-walled material. Likewise, with use of an external vacuum, the amount of draw out and pressure necessary for producing the temporary convex side walls can be controlled depending on the level to which the contents are filled within the container.

Claims

1. A process for hot filling a thermoplastic container, so as to avoid deformation and collapse of the container, which comprises the steps of:
- continuously applying a vacuum means to the original side walls of a thermoplastic container so as to draw out concave indentations in said original side walls of said container into a convex shape;
- filling said container with desired contents, during continuous application of said vacuum means;
- sealing said container by an appropriate sealing means during continuous application of said vacuum means;
- discontinuing said vacuum means; and
- cooling said container so that said convex side walls of said container invert to said indentations of a concave shape.

2. The process of claim 1, wherein a container is employed that been manufactured with original side walls in a concave shape.

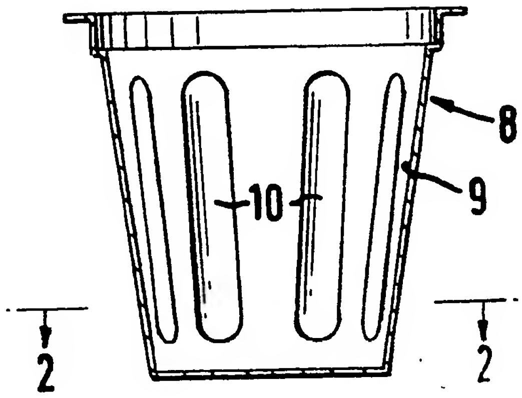

FIG.1

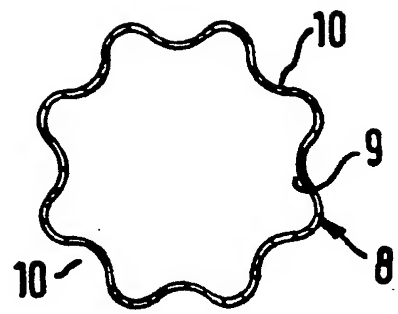

FIG.2

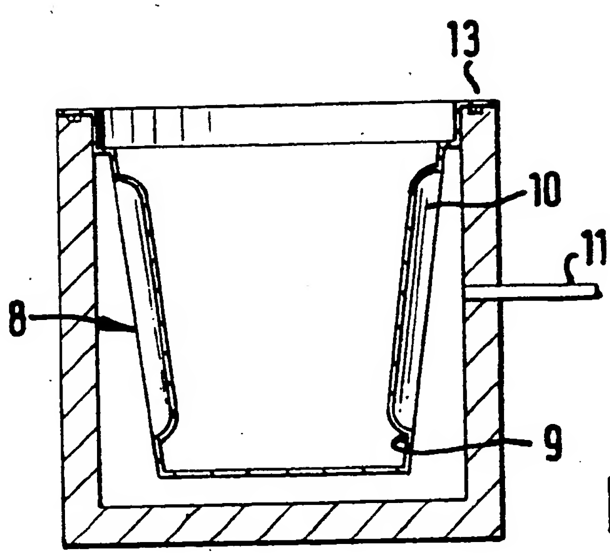

FIG.3

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EUROPEAN SEARCH REPORT

Application number

EP 86 20 2095

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
A	DE-A-3 116 458 (RAKU) * Page 13, line 5 - page 15, line 19; figures 1-5 *	1	B 65 B 61/00 B 65 B 3/04
A	EP-A-0 131 862 (TOPPAN) * Page 1, lines 5-13; page 7, lines 6-10; figures 7-12 *	1,2	
A	CH-A- 524 504 (FISCHER) * Column 2, lines 18-51; figures 1-5 *	1	

			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			B 65 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25-02-1987	CLAEYS H.C.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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